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ABSTRACT

The nature of the relationship between cognitive flexibility and ability to learn prose material differing in cognitive demand was investigated. Ninety-four Ss were administered (1) a prose learning task incorporating subtasks from the first four levels of Bloom's Taxonomy and (2) the PM Scale, a measure of cognitive flexibility. It was hypothesized that cognitively flexible Ss would perform significantly better on the comprehension, application and analysis levels than subjects characterized as less flexible. Performance of flexible and non-flexible Ss was hypothesized to not differ significantly on the knowledge task. Performance of flexible and non-flexible Ss differed significantly (p less than .01) on all four levels of Bloom's Taxonomy. Relationships between PM subscales and cognitive subscales are explored in an initial attempt to "unpack" the observed general relationships. (Author)

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The Relationship of Cognitive Flexibility to Learning of Prose Material Differentially Classified According to the Taxonomy of Educational Objectives: Cognitive Domain

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ABSTRACT

The nature of the relationship between cognitive flexibility and ability to learn prose material differing in cognitive demand was investigated. Ninety-four Ss were administered (1) a prose learning task incorporating subtasks from the first four levels of Bloom's Taxonomy and (2) the PM Scale, a measure of cognitive flexibility. It was hypothesized that cognitively flexible Ss would perform significantly better on the comprehension, application and analysis levels than subjects characterized as less flexible. Performance of flexible and non-flexible Ss was hypothesized to not differ significantly on the knowledge task. Performance of flexible and non-flexible Ss differed significantly ($p < .01$) on all four levels of Bloom's Taxonomy. Relationships between PM subscales and cognitive subscales are explored in an initial attempt to "unpack" the observed general relationships.

Rokeach (1960) proposed the label "dogmatism" as the generic name for the personality construct open vs. closed minded. He postulated that closed minded or high dogmatic individuals: (a) ward off or reject information not compatible with their personal belief systems; (b) isolate beliefs, disbeliefs, and information components from each other; (c) possess little differentiation within disbelief systems and little objective information concerning these systems; (d) perceive the environment as threatening and; (e) perceive authority as punishing and absolute and, as a result, judge information on the basis of its source rather than on its intrinsic merit. (Rokeach, 1960, pp. 55-56)

Most applications of the construct have been with respect to inter-personal relations and personal ideology. However, some studies (Ehrlich, 1961; Fillenbaum and Jackson, 1961; Kemp, 1963; Long and Ziller, 1965; Mouw, 1969) have addressed themselves to the relationship between dogmatism and cognitive functioning.

Mouw (1969) observed that each research study concerning dogmatism and cognitive functioning has employed a restricted criterion variable based on a single type of learning task. His study avoided this problem by employing one of the learning tasks and criterion instruments developed by Kropp and Stoker (1966) which measure the cognitive processes defined by Bloom (1956). Mouw used the first five scales of the Kropp and Stoker instrument corresponding to the first five levels of Bloom's cognitive taxonomy. These include the knowledge, comprehension, application, analysis and synthesis subscales (See Mouw [1969] for a brief description of each category).

Mouw reasoned that as one progresses through the subscales from knowledge to synthesis, the tasks demand increasing amounts of personal responsibility and autonomous involvement in actively processing and transforming the information provided. Thus the higher level subtasks (e.g., synthesis) should require greater independence from direction and control of an authority than the lower level tasks

(e.g., knowledge). Thus he hypothesized that the scores of open- and closed-minded students would be increasingly disparate (open-minded students performing better) as one progresses from the low through the high level cognitive skills. This hypothesis regarding the linear trend across scales was supported, but a direct comparison of high and low dogmatic Ss in each criterion subscale was not conducted.

Mouw's second hypothesis was based on another specific trait posited by Rokeach. Mouw reasoned that since high dogmatic individuals tend to isolate information components from each other, high dogmatic Ss would perform less well on learning tasks requiring integration of information than on those tasks not requiring this capability. Specifically, he hypothesized that difference scores on analysis and synthesis subscales would be significantly lower for open-minded (low dogmatic) Ss than for closed-minded (high dogmatic) Ss. This hypothesis was not supported.

The hypotheses tested by Mouw are based on individual characteristics posited to be components of the dogmatism construct. However, the dogmatism scale is a conglomerate instrument. Subscales designed to correspond with characteristics of the construct were not developed or identified by Rokeach. Availability of instruments corresponding to construct attributes would facilitate validation of the construct.

Felker and Smith (1966) designed and validated an instrument (PM Scale) to measure cognitive flexibility (philosophic mindedness) based on an earlier theoretical explication of the construct by Smith (1956).

Cognitively flexible individuals are postulated to possess four relevant characteristics: (a) freedom from psychological rigidity which primarily includes the ability to judge situations accurately and to appropriately adapt actions to the situation (PM_1); (b) ability to evaluate ideas without regard to their source (PM_2); (c) ability to see issues as many sided rather than two sided and to

construct a relatively large number of alternate hypotheses, explanations or viewpoints (PM_3); (d) tolerance for tentativeness and suspended judgment coupled with willingness to take action in ambiguous situations when necessary (PM_4). (Felker and Smith, 1966, pp. 4-7; Felker 1966, p. 1008)

Empirical research using this instrument has been restricted to studying the relationship between PM scores and rater judgments of cognitive flexibility and to the effect of training in cognitive flexibility on the participants' PM scores. (Felker and Smith, 1966).

While Felker and Smith (1966) maintain that the constructs dogmatism and PM differ in intent [p. 17], it is clear that the attributes overlap to a great extent and in some cases appear identical.

Availability of the PM Scale provides an opportunity to pursue general relations similar to those investigated by Mouw (1969) and to carry out exploratory analyses designed to further "unpack" the posited theoretical relations by investigating empirical relationships between PM subscales and performance on cognitive subscales. Additionally this study provides further empirical exploration of the PM Scale.

In summary, this study investigates the relationship existing between cognitive flexibility (PM) and the ability to "learn" prose material differing in cognitive demands according to the taxonomy of educational objectives: cognitive domain. The writings of Bloom and associates (1956) suggest differential relationships across cognitive categories. They stated, "The knowledge category requires remembering. In the other categories, remembering is only one part of a much more complex process of relating, judging and reorganizing" (Bloom, et.al, 1956, p. 62).

The research hypothesis for this study was:

> Ss characterized as cognitively flexible (high PM) will perform significantly better than those characterized as less flexible on tasks at the comprehension, application, and analysis levels but not the knowledge level.

In addition, the nature of relationships existing between performance on each of the four cognitive flexibility subscales and "achievement" on each taxonomic level of the cognitive domain was investigated in order to provide a basis for future research.

Method

Ninety-four college age Ss fulfilled a course requirement by participating in this study. All tests were administered to Ss in groups.

Ss were told that they were participating in a study concerning the way people learn from textual material. They were instructed that they would be given a reading passage entitled "Lisbon Earthquake" which they were to study. It was indicated that they would have thirteen minutes to study the passage after which they would turn in the passage and take a multiple choice test concerning the material in the article. Ss were told that 50 minutes would be allowed for completing the test.

The criterion test (Lisbon Earthquake) was an 80 item multiple choice test composed of 20 items from each of the first four taxonomic levels of the cognitive domain. The test was developed and validated by Kropp and Stoker (1966).

After completing the criterion test, aSs completed the PM Scale. The PM Scale yields a total score representing cognitive flexibility and four subscale scores, each corresponding to one of the four cognitive flexibility characteristics previously identified. Ss were instructed that they would have 60 minutes to complete the PM Scale.

Data for each of the criterion subscales (knowledge, etc.) was analyzed separately through use of regression analysis (Kelly, et.al., 1969). The research hypothesis was tested by using the total PM score (PM_{Tot}) to predict each criterion variable. Support would be provided for the research hypothesis if PM_{Tot} is a significant predictor of performance on the comprehension, application and analysis subscales but not of performance on the knowledge subscale.

Exploratory analyses were computed by regression analysis using single PM subscales as predictors for each criterion subscale. This method provided information regarding the nature of relationships (linear or curvilinear) as well as tests of significance.

Results

The research hypothesis for this study stated that PM_{Tot} would be a statistically significant ($p < .01$) predictor of performance on the comprehension (C), application (Ap) and analysis (An) subscales but not on the knowledge (K) subscales of the Kropp and Stoker instrument. Table 1 presents the linear regression analysis data corresponding to this hypothesis. Curvilinear relations were nonsignificant and are not reported.

Insert Table 1 about here

PM_{Tot} is a significant predictor of performance on K as well as C, Ap and An. The research hypothesis is not statistically supported. However, it is the case that PM_{Tot} accounts for more variance on the C, Ap and An subscales than on the K subscale.

Figure 1 presents the mean performance on cognitive subscales for Ss divided into upper, middle and lower groups on the basis of PM_{Tot} test score.

Insert Figure 1 about here

Visual inspection of Fig. 1 indicates that mean cognitive achievement difference scores for upper and lower PM_{Tot} groups are greater on C, Ap and An subscales than on the K subscale. However, the magnitude of the difference is small.

Proceeding to the exploratory analyses for PM subscales, Table 2 indicates the amount of cognitive subscale variance accounted for by each PM subscale and indicates the nature and statistical significance of the relationship between each PM subscale and each cognitive subscale.

Insert Table 2 about here

Inspection of Table 2 reveals that one PM subscale (PM_2) is not significantly related to performance on any cognitive subscale. PM_2 purports to measure the Ss ability to evaluate ideas apart from their source.

Two significant curvilinear relationships were observed. Performance on PM_3 is curvilinearly related to performance on both Ap and An. Figure 2 and 3 indicate the nature of the curvilinear relationships.

Insert Figures 2 and 3 about here

In both cases of significant curvilinear relationships, PM_3 scores of five and below seem to be primary determinants of the curvilinear nature of the relationships. Ss with PM_3 scores of five and below generally perform better on the Ap and An scales than do Ss with PM_3 scores of six and seven. The remainder of each distribution appears to approach linearity.

Looking again at Table 2 for general patterns in the relationships between PM and cognitive subscales, it is apparent that the PM subscales are differentially predictive of the cognitive subscales. PM_4 is the only statistically significant predictor of the K subscale. PM_1, PM_3, and PM_4 are all approximately equal predictors of C. PM_3 and PM_4 both predict Ap with PM_3 being by far the best predictor. PM_1 and PM_3 both predict An with PM_3 being a slightly better predictor.

PM_3 is the strongest of the PM subscales as an overall predictor. It correlates significantly with three cognitive subscales and is the best predictor of two. PM_4 also is a statistically significant correlate of three cognitive subscales and is the best predictor of one. PM_1 is a statistically significant correlate of two subscales and is the best predictor of one. PM_2 is not a significant predictor of any cognitive subscale.

Table 3 presents the mean cognitive subscale achievement for subgroups divided by PM scores. Description of the results for upper and lower subgroups is clearcut. In all cases (PM_{Tot} and subscales across all cognitive subscales) mean performance of the upper group is better than mean performance of the lower group.

Insert Table 3 about here

Performance of the middle subgroup leads to a less simple description. The relationship of the middle subgroup to the upper and lower subgroups is stable across cognitive subscales but the same relationship does not obtain for the PM_{Tot} and for each of the PM subscales. The PM_{Tot} middle subgroup cognitive performance clusters with that of the PM_{Tot} upper subgroup across the K, C, Ap and An subscales. This relationship also obtains with the PM_1 subgroup. However, with the PM_2, PM_3, and to some degree with the PM_4 subscales, the middle subgroup cognitive subscale scores more closely approximate those of the lower subgroup than the scores of the upper subgroup.

Discussion

Based on the assumption that the knowledge category requires only a simple memory process while the other cognitive categories require memory as only one part of a more complex process of relating, judging and reorganizing, it was hypothesized that Ss with high PM_{Tot} scores would perform significantly better

than Ss with low PM_{Tot} scores on the C, Ap and An subscales but not on the K subscale. Ss with high PM_{Tot} scores performed significantly better on all cognitive subscales than did Ss with low PM_{Tot} scores. Support for the hypothesis was not provided by this study. Most of the variance accounted for by PM_{Tot} appears to be attributable to the PM_4 subscale. Future studies should concentrate on investigating the nature of the relationship between PM_4 and learning of knowledge level cognitive tasks.

PM_2, which purports to measure the Ss' tendency to evaluate ideas without regard to their source, does not correlate significantly with any cognitive subscale. This theoretical facet of the dogmatism construct was the basis for Mouw's hypothesis of differential linear trends across cognitive subscales for high and low dogmatic individuals. His hypothesis was statistically supported. Data from the present study is discrepant with Mouw's findings.

The discrepancy between present findings and those presented by Mouw could be a result of (a) sampling error or population differences, (b) omission of the synthesis scale (an essay instrument) in the present study, or (c) lack of validity of PM_2 as an indicator of the above mentioned facet of the dogmatism construct. If it is not a result of one of these factors, then it would appear that the attribute itself is not related to performance on the cognitive subscales and that the observed relationship described by Mouw is a function of some other attribute represented in the dogmatism scale.

The curvilinear relationships observed between PM_3 (Seeing Issues as Many Sided) and the Ap and An cognitive subscales are of interest in that significant curvilinear relationships with academic achievement are typically obtained only with anxiety measures. The curvilinear relationships were first observed after analysis of data for the original sample of 54 Ss. Due to the relative uniqueness of these findings, 40 additional Ss were run to ascertain whether the originally observed relationships would hold up. Analysis of the data verified the curvilinear nature of the relationships.

The following would appear to offer one plausible explanation of the significant curvilinear relationships between PM_3 and the Ap and An cognitive subscales. The small minority of Ss exhibiting extremely low PM_3 scores, indicating a belief that issues have only one or two sides, may do so as the result of having carefully considered deeply ingrained positions on popular issues. For example, it is conceivable that the more "intellectual" students from highly structured fields (e.g. "hard" sciences and mathematics) may pass through a "stage" of academic development in which the belief in one and two sided issues is characteristic. Likewise their penchant to carefully consider issues and/or some natural selection process which determines entrants into these fields could result in the observed achievement scores which exceed those expected for a projected linear relationship.

The "average" students with less well-considered and less systematic positions might be expected to characterize some issues as two sided and others as many sided thus leading to a less extreme PM_3 score. Likewise their academic achievement scores might be expected to be lower than those of the authoritarian "neo-intellectuals" discussed above.

Finally the majority of "intellectual" students including those from less structured fields and those from the "hard" sciences and from mathematics who have progressed beyond the hypothesized interim training stage might be expected to score high on PM_3 indicating a belief that most issues are many sided, and might be expected to score higher than the "neo-intellectuals" or the average students on the higher level cognitive subscales.

Future research should explore the specific explanation described above and/or similar explanations relating prior experience and present interests of Ss to performance on the PM Scales and to academic achievement on the various cognitive subscales. Minimally, the curvilinear relationships obtained in this study suggest one cannot reasonably generalize that the higher the PM_3 score the better the higher level cognitive achievement. Whether this conclusion generalizes across other dependent variables remains to be seen.

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Table 1

Linear Regression Analyses Using PM_{Tot} to Predict Performance on Each of the Cognitive Subscales

Condition	R^2 Full	R^2 Restricted	df	F	p
PM_{Tot} - K	.09	.00	1/92	8.96	.004
PM_{Tot} - C	.14	.00	1/92	14.46	.0003
PM_{Tot} - Ap	.10	.00	1/92	10.54	.002
PM_{Tot} - An	.11	.00	1/92	10.86	.001

Table 2

Cognitive Subscale Variance Accounted for by Each PM Subscale and the Statistical Significance of Each Relationship

	Nature of Relationship	df	K	C	Ap	An
PM_1	Curvilinear	1/91	.04 NS	.07 NS	.03 NS	.11 NS
	Linear	1/92	.03 NS	.07 p=.01	.03 NS	.10 p=.002
PM_2	Curvilinear	1/91	.04 NS	.04 NS	.03 NS	.00 NS
	Linear	1/92	.01 NS	.04 NS	.03 NS	.00 NS
PM_3	Curvilinear	1/91	.05 NS	.06 NS	.15 p=.008	.14 p=.006
	Linear	1/92	.03 NS	.04 p=.05	.08 p=.007	.06 p=.01
PM_4	Curvilinear	1/91	.08 NS	.07 NS	.05 NS	.02 NS
	Linear	1/92	.07 p=.008	.06 p=.02	.05 p=.04	.02 NS

Table 3

Mean Achievement on Bloom Subscales
for Subgroups Divided by PM Scores

	Knowledge	Comprehension	Application	Analysis
All 94 Ss	16.89	14.19	11.02	10.39
Upper 1/3 PM_{Tot}	17.84	15.19	11.87	11.35
Middle 1/3 PM_{Tot}	17.06	14.78	11.91	10.90
Lower 1/3 PM_{Tot}	15.77	12.58	9.26	8.96
Upper 1/3 PM_1	17.45	15.00	11.26	11.61
Middle 1/3 PM_1	17.31	14.75	11.97	10.60
Lower 1/3 PM_1	15.99	12.81	9.81	9.00
Upper 1/3 PM_2	17.48	14.84	12.00	10.87
Middle 1/3 PM_2	16.50	13.84	10.41	10.13
Lower 1/3 PM_2	15.71	13.90	10.68	10.26
Upper 1/3 PM_3	17.32	14.68	12.26	11.55
Middle 1/3 PM_3	16.84	13.97	10.34	9.78
Lower 1/3 PM_3	16.52	13.94	10.48	9.94
Upper 1/3 PM_4	18.00	14.90	11.87	11.03
Middle 1/3 PM_4	16.38	14.13	10.94	10.16
Lower 1/3 PM_4	16.32	13.55	10.26	10.06

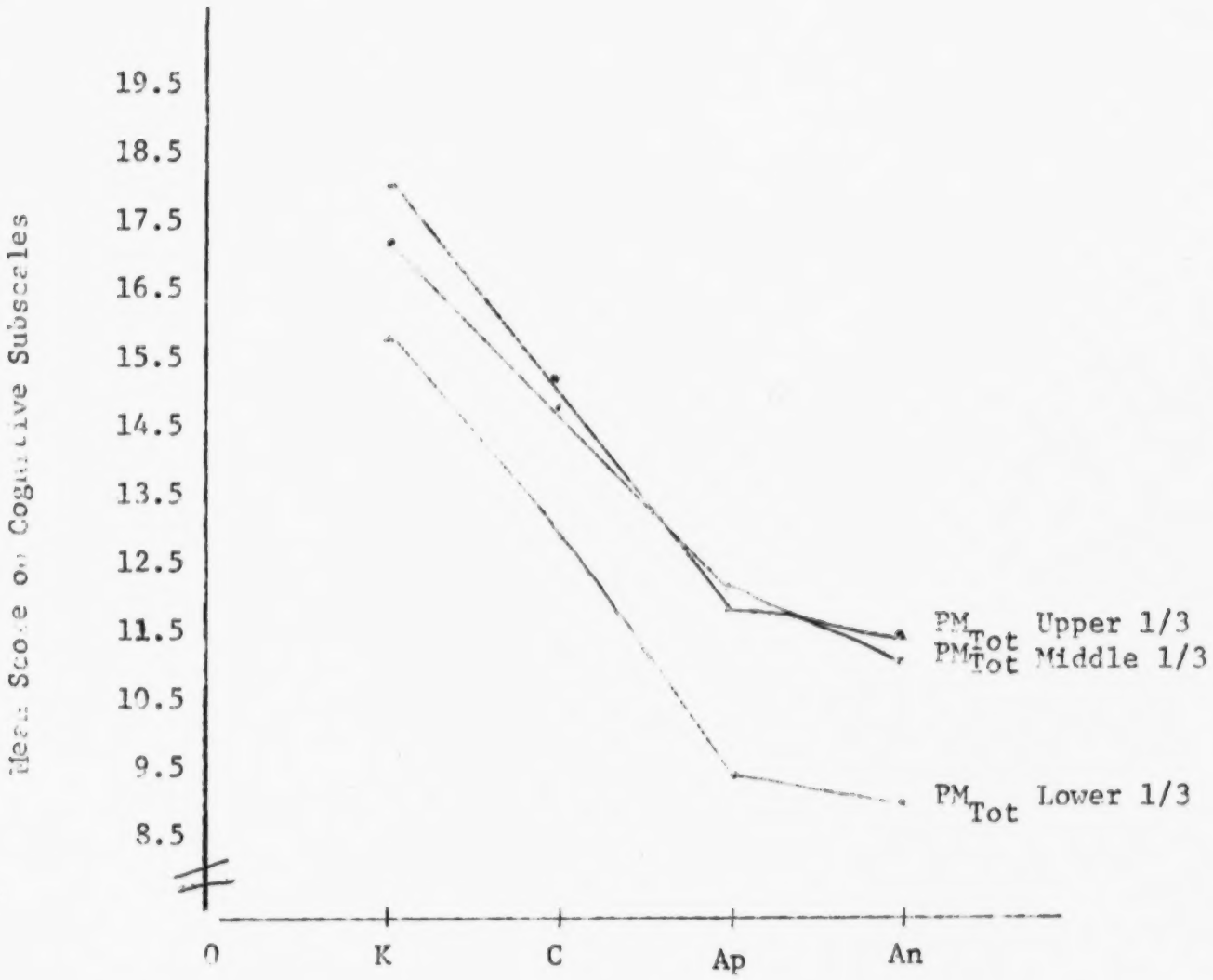

Figure 1. Mean performance on cognitive subscales for Ss divided according to total PM test scores.

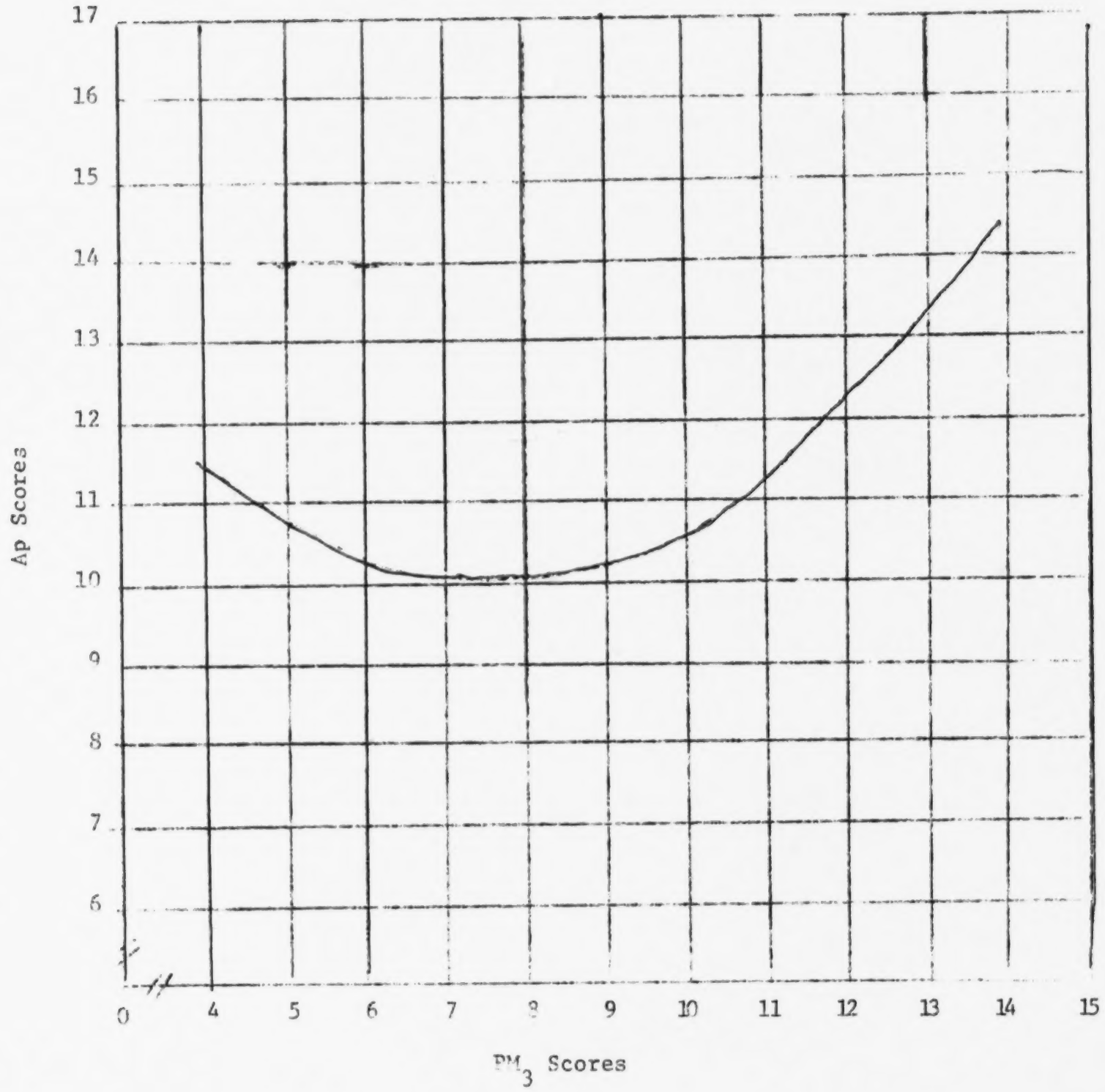

Figure 2. Line of best fit for bivariate plot of PM_3 and Ap subscale scores.

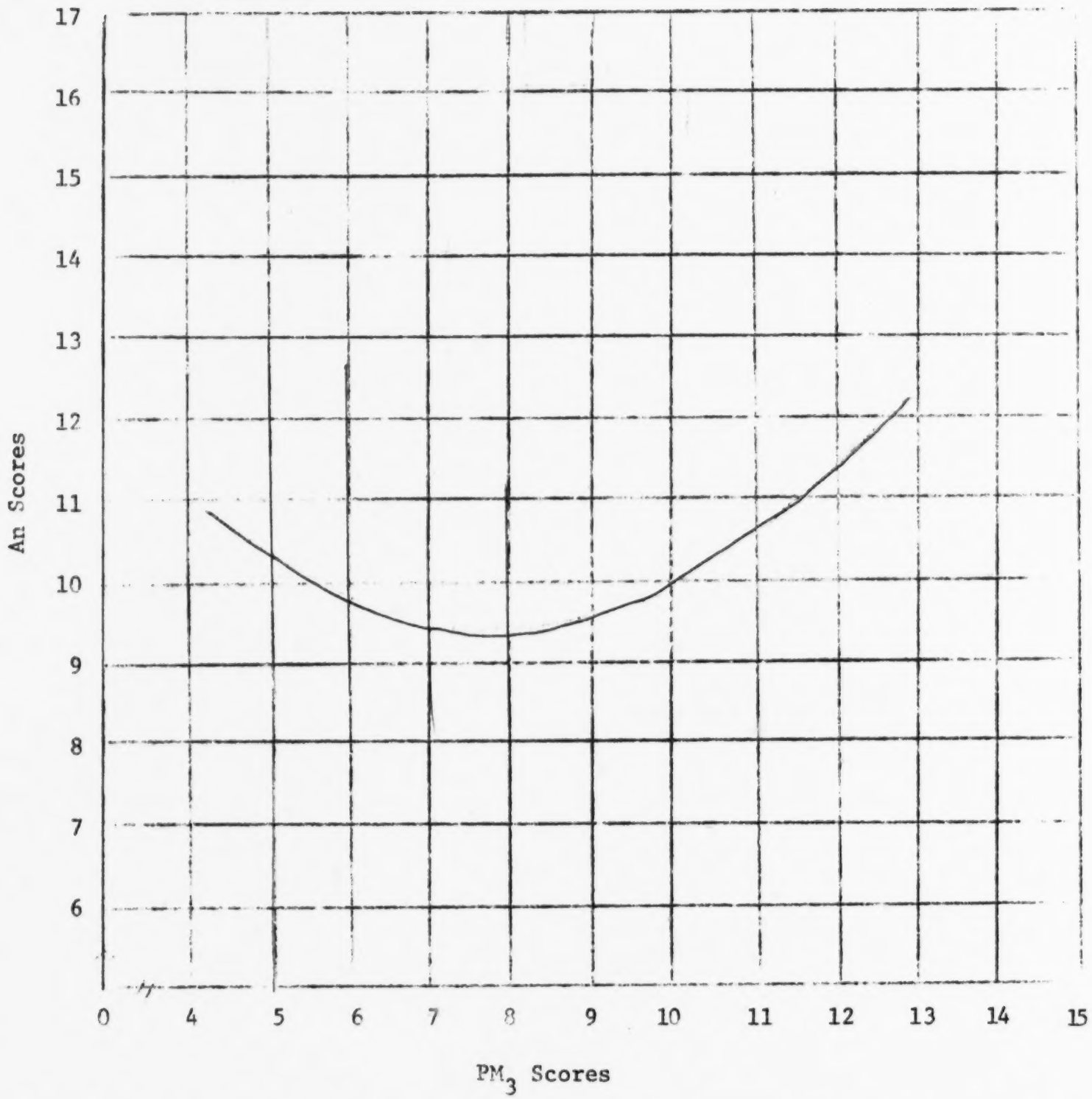

Figure 3. Line of best fit for bivariate plot of PM_3 and An subscale scores.

Appendix

Description of PM Scales and Example Items From Each Scale

Pif_1 Freedom From Psychological Rigidity

A person free from psychological rigidity is one capable of judging situations accurately and appropriately adapting his actions to the situation.

Example Items

Choose the one characteristic in each pair that would more likely be possessed by a <u>teacher</u> that you would admire and whose judgment you would respect.

47. a. Is expert at using the more commonly recognized teaching methods.

    *b. Has a number of unusual and novel lesson plans and ideas for each subject that he teaches

Choose the statement in each pair that is more acceptable to you.

61. a. Most failures in solving problems are due to mistakes in applying the correct techniques.

    *b. Most failures in solving problems are due to using an incorrect approach to the problem.

PM_2 Evaluating Ideas Apart From Their Source

One who scores high on this scale verbalizes (1) an unwillingness to accept an argument simply on the basis of authority and (2) a willingness to consider an argument or idea even if one dislikes the proponent of that idea.

Example Items

Choose the statement that is more acceptable to you.

74. a. You can usually tell what a professor's "philosophy of life" is after the first few lectures just by the terms he uses.

    *b. When a professor's lecture irritates you, it is a good idea to try to put the professors' ideas into different words from the ones that he used in presenting the ideas.

73. a. If a man is an expert in a field it means that you can trust what he says about matters in that field as being correct.

    *b. Unless you have some specific and definite reason to doubt what he says you should accept what an expert says as being correct.

PM_3 Seeing Issues as Many Sided Rather Than Two-Sided

Persons who score high on this scale are posited to reject black and white thinking and to actively search for (and develop) large numbers of alternate hypotheses, explanations, viewpoints, etc.

Example Items

Choose the one characteristic in each pair that would more likely be possessed by a person whom you would admire and whose judgment you would respect.

39. a. Has the ability to decide on an issue and to stick with his decision.

*b. Has the ability to propose many alternate explanations and views on most issues.

Choose the action in each of the pairs which you would more likely take if faced with the situation described above.

29. a. Would suggest that the committee hear from other interested parties.

*b. Would suggest that each committee member try to see the opposite side of the issue.

PM$_4$ Maintaining Tolerance for Tentativeness and Suspended Judgment

A person who scores high on this subscale is posited to be one who can tolerate ambiguity and is willing to make decisions on the basis of incomplete information when a decision is required. However, the person continues to monitor the state of affairs after making the decision and is willing to admit and change decisions when additional information proves the original decision to be wrong.

Example Items

Choose the statement in each pair that is more acceptable to you.

68. a. A person who is intellectually honest will not tolerate contradictory ideas, but will make a choice between the conflicting ideas.

*b. It is desirable at times for a person to admit that he has, and to tolerate, two ideas which are contradictory.

Choose the one characteristic in each pair that would more likely be possessed by a person whom you would admire and whose judgments you would respect.

33. *a. Likes plans which are tentative rather than fixed.

b. Likes things organized so that they run smoothly without changes in plans.